AMENDMENTS TO THE SPECIFICATION:

IN THE TITLE:

Kindly replace the title with the following amended title:

HIGH POWER, LOW NOISE, ~~SUPERFLOURESCENT~~ FLUORESCENT DEVICE AND METHODS RELATED THERETO

IN THE SPECIFICATION:

Kindly replace the paragraph that begins at page 2, line 9 and ends at page 2, line 17 with the following amended paragraph:

For waveguide sources where the output of the source is already in a fiber an appropriate electro-optic modulator can be used such as an integrated optical (IO) Mach Zehnder interferometer. This approach, however, is disadvantageous because of the excess loss [[to]] of the modulator (typically -3 dB) and an additional loss (about -3 dB) to operate in the linear region of the modulator transfer curve (i.e., at quadrature). Another difficulty is polarization in that the output of the fiber superfluorescent source is unpolarized, while the IO interferometer has polarization dependent transfer and drive voltage characteristics.

Kindly replace the paragraph that begins at page 2, line 5 and ends at page 3, line 2 with the following amended paragraph:

It would thus be desirable to provide new methods and devices that yield a high power, broadband, optical [[/]] light source with very low RIN. It would be particularly desirable to provide such a device and method that would yield such an optical source without a loss of ~~insertion~~ intensity, and that can maintain a polarized state in comparison to prior art devices. Such devices preferably would be

simple in construction and less costly than prior art devices and such methods would not require highly skilled users to utilize the device.

Kindly replace the paragraph that begins at page 3, line 5 and ends at page 3, line 14 with the following amended paragraph:

The present invention features a superfluorescent light producing device and a method for reducing relative intensity noise (RIN) in a superfluorescent light source that can provide a polarized optical output more particularly a broadband polarized optical output. A superfluorescent device/ source according to the present invention is particularly advantageous for applications such as high precision navigation and low noise strain sensing. In the present invention, the term broadband shall be understood to mean an output, more particularly an optical output, extending over a range of wavelengths and frequencies. In particular, the term broadband can refer to a ~~where the~~ bandwidth of the range of wavelengths of least 20 nm.

Kindly replace the paragraph that begins at page 4, line 22 and ends at page 5, line 6 with the following amended paragraph:

The output of the modulator is operably and optically coupled to the polarization maintaining (PM) amplifier so the polarized optical output from the modulator is propagated to the PM amplifier. The PM amplifier, including the components making up such an amplifier, is configured and arranged so as to in effect amplify the polarized optical output from the modulator and to provide an amplified polarized optical output that can be used for a given application. This amplified polarized optical output comprises the optical output of the superfluorescent light producing device/source of the ~~print~~ present invention.

Kindly replace the paragraph that begins at page 6, line 18 and ends at page 6, line 23 with the following amended paragraph:

The retro-reflecting orthogonal polarization converter is optically coupled to the beam splitter such that this reflected amplified optical output in the orthogonal polarization state is inputted to the beamsplitter. The beamsplitter also is configured so that the reflected amplified optical output having the orthogonal polarization state is directed into another optical pathway. The ~~another~~ other optical pathway is arranged so as to be at an angle (for example 90°) with respect to the optical pathway that inputs the polarized optical output from the modulator to the beamsplitter. The reflected amplified polarized optical output being outputted by the beamsplitter comprises the polarized light or polarized, amplified optical output of the superfluorescent light producing device/ source of the present invention.

Kindly replace the paragraph that begins at page 7, line 1 and ends at page 7, line 7 with the following amended paragraph:

In a particular embodiment, the amplification light source is a laser pump diode, the second doped optical fiber is a doubleclad rare-earth doped optical fiber and the retro-reflector is a Faraday mirror, more particularly a Faraday rotator mirror. In a specific embodiment, the rare-earth dopants are erbium and yetterbium, however, it is within the scope of the present invention for other rare-earth materials, alone or in combination, to be utilized to dope the optical fiber.

Kindly replace the heading at page 8, line 15 with the following amended heading:

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Kindly replace the paragraph that begins at page 8, line 16 and ends at page 9, line 4 with the following amended paragraph:

For a fuller understanding of the nature and desired objects of the present invention, reference is made to the following detailed description taken in conjunction with accompanying drawing figures wherein like reference character denote corresponding parts throughout the several views wherein:

FIG. 1 is a block diagram of a superfluorescent light producing device or source according to the present invention;

FIG. 2 is a graph showing the broadband optical outputs of an exemplary seed source ~~and~~ with and without a polarization maintaining amplifier;

FIG. 3 is a graph showing the frequency response of RIN, with and without a feedback circuit being implemented, where the frequency response of the detector has been normalized out; and

FIG. 4 is an exploded view of the data from ~~figure~~ FIG. 3 plotted to 200 kHz.

Kindly replace the heading at page 9, line 6 with the following amended heading:

DESCRIPTION OF ~~THE~~ PREFERRED EMBODIMENTS ~~EMBODIMENT~~

Kindly replace the paragraph beginning at page 10, line 3 and ending at page 10, line 14 with the following amended paragraph:

Before providing a more detailed description of the superfluorescent source 10, including the components or features thereof, the overall operation of such a superfluorescent source including the general function of the components thereof is first discussed. The seed source 20 generates a optical signal or light output that is generally characterized as being broadband having a range of pre-selected wavelengths/ frequencies and as having no particular polarization state. This light output, hereinafter the seed source optical input, is fed to the modulator 40. Although the optical signal or light is considered broadband it is common practice to characterize or describe a broadband output by referring to a specific wavelength or frequency being outputted within the range. The output of the source 10 output is

preferably broadband, e.g., has a bandwidth of the range of wavelengths of at least 20 nm, and in embodiments described herein, is about 20 - 40 nm or about 20-50 nm.

Kindly replace the paragraph that begins at page 13, line 4 and ends at page 13, line 12 with the following amended paragraph:

In a particular exemplary embodiment, the light source 22 is a pump diode emitting light at about 980 nm, typically a narrow band output at about 980nm, and the pre-selected gain material or dopant for the first doped optical fiber 28 is erbium. In such a case, the erbium doped optical fiber produces an ASE at about 1550nm responsive to the 980nm light from the light source. Also, the ASE from the first doped optical fiber [[22]] 28 is counter propagated in the first doped optical fiber, in other words propagated in a direction that is opposite to that in which the light from the light source 22 is injected or launched in the first doped optical fiber.

Kindly replace the paragraph that begins at page 13, line 13 and ends at page 13, line 20 with the following amended paragraph:

In the illustrated embodiment, the first doped optical fiber [[20]] 28 ~~also~~ is formed in a continuous loop to provide a sufficient length of the first doped optical fiber while proving a relatively compact structure. It is within the scope of the present invention, however, for the first doped optical fiber to be arranged in any geometric configuration and/ or optical configuration adaptable for use in accordance with the teachings of the present invention. In an exemplary embodiment, the first doped optical fiber [[20]] 28 is formed in a continuous serpentine loop having an overall or total length in the range of 5-10 m.

Kindly replace the paragraph that begins at page 19, line 17 and ends at page 20, line 3 with the following amended paragraph:

The amplified optical signal or output exiting the second doped optical fiber 60 is then propagated to the retro-reflecting orthogonal polarization converter 62, which reflects this amplified optical output such that it [[~~is~~]] counter propagates back through the second doped optical fiber. In addition to reversing the direction of propagation, the retro-reflecting orthogonal polarization converter 62 also reflects the amplified optical output in an orthogonally polarized state. In particular, the retro-reflecting orthogonal polarization converter 62 reflects the amplified optical output such that it is in an orthogonal polarization state different from that of the polarization state of the optical output from the modulator 40.

Kindly replace the paragraph that begins at page 20, line 4 and ends at page 20, line 14 with the following amended paragraph:

In a specific exemplary embodiment the retro-reflecting polarization converter 62 is a Faraday mirror retro-reflector as is taught and disclosed in USP 5,303,314, the teachings of which are incorporated herein by reference. See also Duling, I.N. and Esman, R.D. Single-Polarisation Fiber Amplifier [[.]] , Electronics Letters 28(12), pages 1126-1128, 1992, the teachings of which are incorporated herein by reference, which discloses a Faraday mirror including a 45° Faraday rotator and a conventional mirror. This specific exemplary embodiment, however, shall not be construed as a limitation as it is within the scope of the present invention, for any type of device that is capable of reflecting the light in an orthogonal polarization state can be adapted for use in the superfluorescent source 10 according to the present invention.

Kindly replace the paragraph that begins at page 22, line 1 and ends at page 22, line 12 with the following amended paragraph:

In an exemplary embodiment, and as illustrated in FIG. 1, the control mechanism includes a polarization maintaining (PM) optical tap 80 and a feedback loop 110 that are operably and optically interconnected to each other by means of a polarization maintaining optical fiber 100. The PM optical tap

80 is any of a number of devices or couplers known in the art that cross couple or transfer an optical signal from one optical fiber to another optical fiber. The PM optical tap 80 is more particularly configured so a portion of the polarized amplified ~~polarized~~ optical output from the PM amplifier 50, as it passes through the PM optical tap 80 (tapped-off portion), is re-directed (e.g., tapped off or sampled) into the polarization maintaining fiber 100 and inputted into the feedback loop 110. The tapped-off portion, is representative of the intensity of the amplified polarized optical output from the PM amplifier 50.

Kindly replace the paragraph that begins at page 23, line 11 and ends at page 23, line 22 with the following amended paragraph:

The detector 112 and amplifier 114 making up the feedback loop 110 serve as a mechanism to monitor the amplified polarized output from the PM amplifier 50 and to reduce the noise in the optical output 70 as well as to reduce or compensate for amplitude variations in this output that arise for any of a number of other reasons such as those attributable to age related component degradation. For example, if the intensity or power of the amplified polarized optical output increases beyond a desired value, the tapped-off portion will be at a correspondingly higher intensity. Consequently, the detector 112 and feedback loop amplifier 114 will output an electrical control signal or voltage to the modulator 40 that in turn ~~decreases~~ decreases the optical signal transmissivity of the modulator 40, thus also decreasing the intensity or power of the optical output 70.

Kindly replace the paragraph that begins at page 26, line 1 and ends at page 26, line 8 with the following amended paragraph:

The Relative intensity noise (RIN) reduction of the present invention is illustrated in FIG. 3, which shows the frequency dependence of RIN with and without a feedback circuit being implemented in the ~~superfluoescent~~ superfluorescent source 10 of the present invention. As seen therein, at frequencies less than 1.7 MHz, RIN is significantly decreased by the inclusion of a feedback loop in the superfluorescent

source 10. This is particularly advantageous for most ~~gyro-optic~~ fiber optic gyroscope applications because such applications typically utilize frequencies below 1 MHz.